

# Can IBM Blue Gene/L compete with the Earth Simulator as a Climate Computer?

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# Short Answer: Yes

- Estimated sustained performance on T1279L96 (AFES) with 2-d decomposition is **~38 Tflops** (vs 28)
- Latency/ efficiency of Legendre transforms are critical parameters.
- Naming Derby: IBM **Blue-Planet** ?

# Model of Spectral Dynamics Algorithm

- Consider FFT and LT in Spectral Dynamics and related transposes only.
- Assume seven 3-d fields to transform 3-d primitive equation model.
- Assume parity property of Associated Legendre Polynomials is used to cut LT operation count in half.

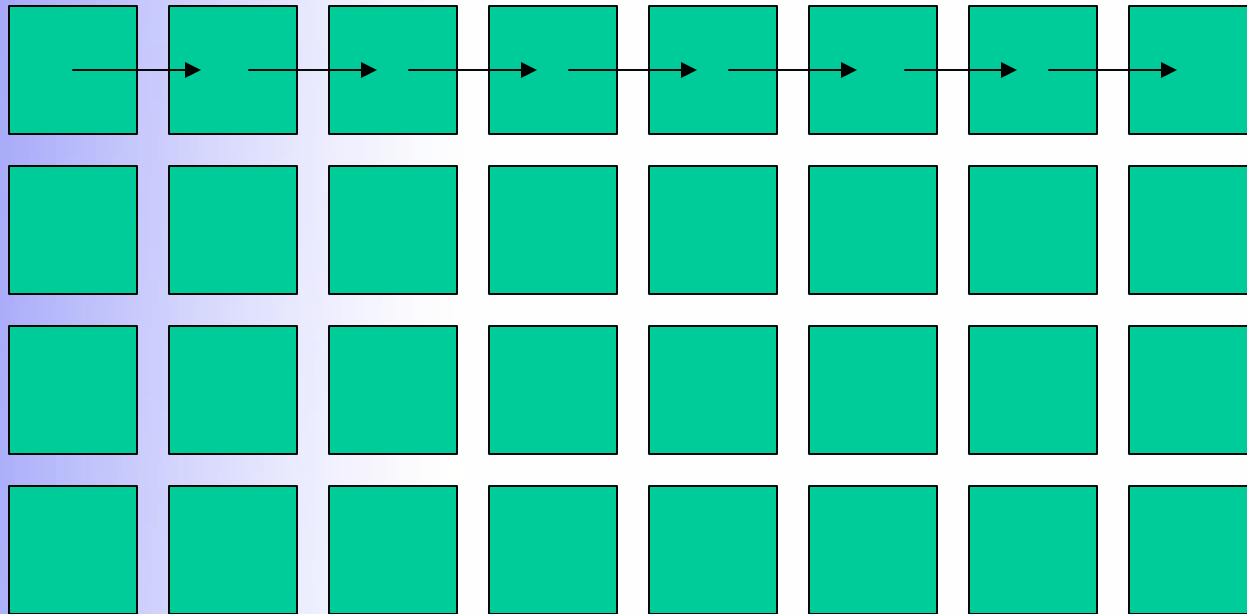
# BG/L Performance Model Assumptions

- Torus bandwidth = 180 MB/sec
- Torus latency = 5 usec
- FFT efficiency = 30%
- Legendre Transform = 70%

# Performance Model Characteristics

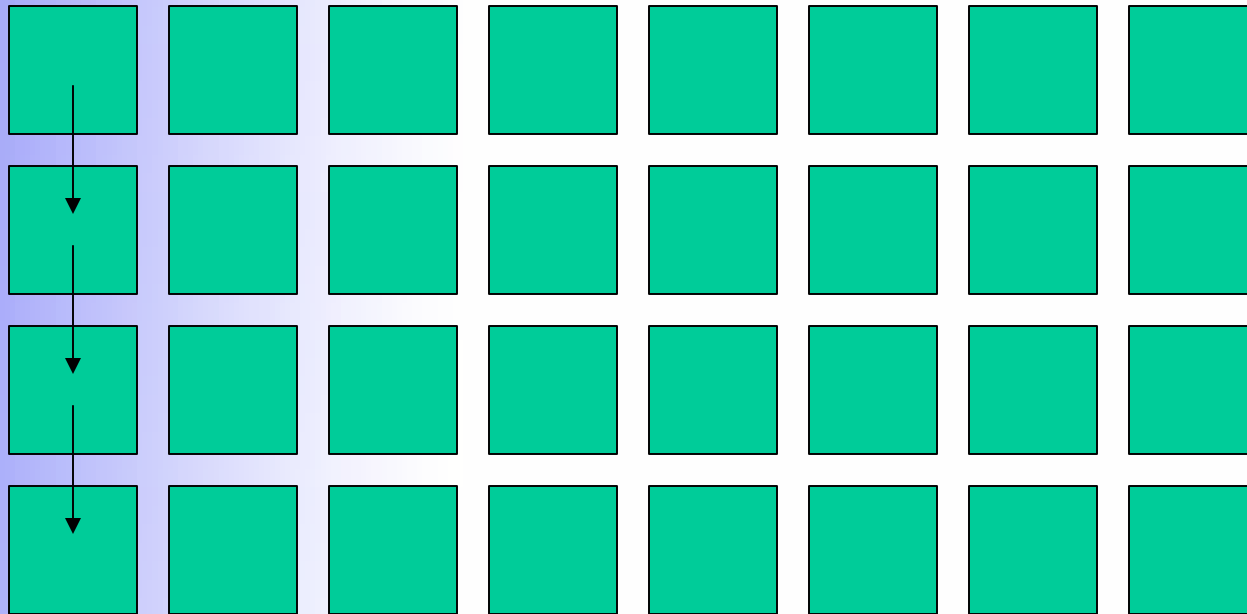
- AFES Grid = 3480 x 1920 x 96 ( $T=1279$ )
- $N_{lyr} \sim 7 * N_{lev} + 1$
- FFT Flops =  
 $2 * N_{lat} * N_{lyr} * 5 * (N_{lon}/2) * \text{LOG2}(N_{lon})$
- LT Flops =  $8 * N_{lyr} * (N_{lat}/2) * ((T+1) * (T+2)/2)$
- Assume 3 transposes  $x-y-x$  in each direction.

# X Direction Transpose



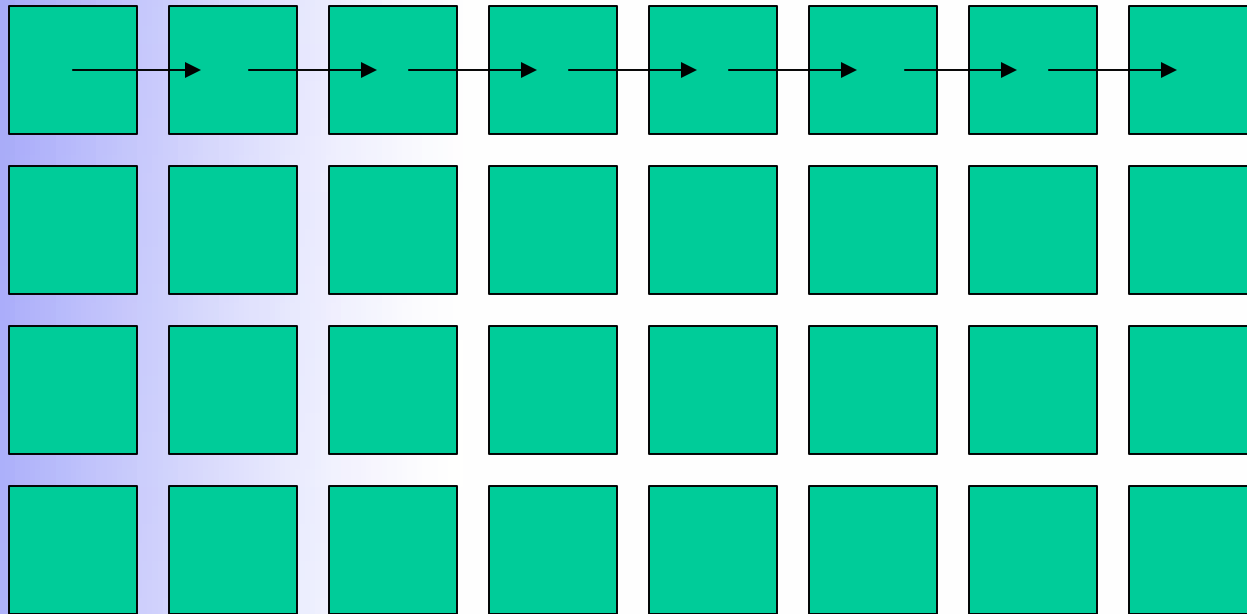
Physics-FFT

# Y Direction Transpose



FFT-Legendre

# X Direction Transpose

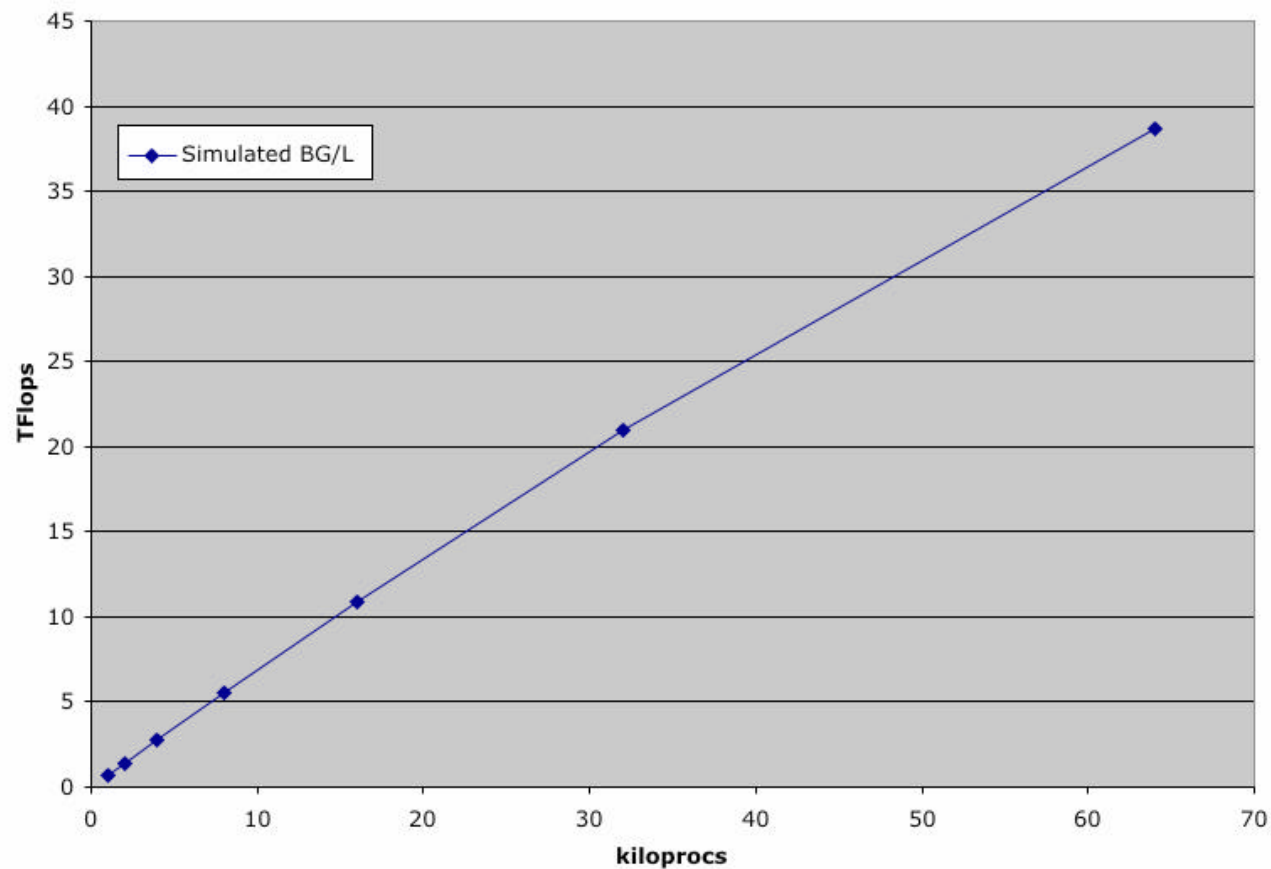


Legendre-Spectral



# BGL Climate Performance

Estimated BG/L Performance: T1279L96



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# Sanity Checks

- ~ 2years/day at 10 km (=useful rate)
- Memory: 3000 3-d fields at 64 kpes.
- I/O ~2Tbytes/day. 23 MB/sec 7x24.
- Brute force method @ high res.
- Explicit AMR may be more efficient.